

## DEPARTMENT OF THE INTERIOR WEATHER PROGRAMS

The Department of the Interior's (DOI) Atmospheric Science activities are primarily research and, historically, have been reported through the Subcommittee for Atmospheric Research. However, budgetary information for the Bureau of Land Management's operational wildfire weather data collection system is reported in this Federal Plan. The narrative below describes the full-range of meteorological activity in the Interior Department.

### Bureau of Land Management

The Bureau of Land Management (BLM) is one of five Federal Land Management agencies which have centralized wildland fire weather operations at the National Interagency Fire Center (NIFC), Boise, Idaho (Figure 3-DOI-1). BLM's Initial Attack Management System (IAMS) was designed in the mid-1980's to provide real-time data access and modeling for the fire management organization. The IAMS required a considerable dedicated telecommunications network for data distribution. In an effort to reduce these inherent telecommunications costs, the BLM has moved into a "web server" environment. This new system is called the BLM Wildland Fire Management Information Site (WFMIS) ([www.nifc.blm.gov](http://www.nifc.blm.gov)). Many of the capabilities that were centrally located in the old IAMS have been moved to other web sites.

The principal inputs to WFMIS are Remote Automatic Weather Station (RAWS) and National Lightning Detection Network (NLDN) information. Additional fire management information is summarized and made available via the Western Regional Climate Center (WRCC) ([www.wrcc.sage.dri.edu](http://www.wrcc.sage.dri.edu)) and the United States Forest Service Wildland Fire Assessment System (WFAS) ([//svinet2.fs.fed.us/land/wfas/](http://svinet2.fs.fed.us/land/wfas/)) web sites

The BLM's RAWS Program primarily collects meteorological data for fire weather forecasting. In past years, the network also provided considerable support to non-fire entities and is oper-

ated throughout the year. However, with increased pressure on operational dollars, the BLM Office of Fire and Aviation Management has decided to restructure its network. Plans were to reduce the fire network by about one-fourth in the western states. However, after considerable study and optimization, actual reductions have been about 15 percent. With continued funding pressures, the requirement to replace aging equipment, and the considerable costs associated with maintaining such a large network, BLM Fire Management's strategy was to reduce the total number of RAWS, move to a single station classification (all stations configured the same), operate only during the traditional western fire season (RAWS no longer maintained in winter months), and to use any savings in operating funds to replace aging equipment and upgrade

the remaining network. However, once again, the expanded use of Fire Managements RAWS data set by other non-fire users has generated funding to permit year-round operation of the entire network. The BLM's Resource Management and Oregon O&C (West-Side) RAWS networks will continue to operate and be supported as in the past. These networks are much smaller and have specific program requirements that differ from fire management.

In 1997, the BLM began contracting with a private vendor via the National Weather Service (NWS) for lightning location data. Data is received at the NIFC in Boise, Idaho and placed on the BLM WFMIS for qualified user access. Current plans are to continue the operation of the Alaska Automatic Lightning Detection System as an independent government-owned and operated system.

### Geographic Areas and Coordination Centers



Figure 3-DOI-1. National Interagency Coordination Center coordinates with the GACCs for wildland fire supplies and resources.

The BLM's Remote Sensing Fire Weather Support Unit at NIFC provides a full range of specialized management, maintenance, data, and support services for the BLM and numerous other government agencies. This interagency staffed and funded facility performs work under long-term interagency agreements with those agencies within the government having similar equipment and requirements. Staffing levels within this group are being adjusted to meet the overall interagency requirements.

In addition to the meteorological monitoring BLM conducts primarily to support wildland fire management activities, BLM also performs site-specific climate monitoring at over 200 manual weather station locations on the public lands in the eleven western states and Alaska. The operation of these sites ranges from seasonal to annual measurements of precipitation, temperature, soil moisture, and other meteorological parameters necessary to assess local climatic influences. These data are primarily used for natural resources management and planning at the local level.

In 1991, the BLM Global Change Research Program established five monitoring sites in BLM wilderness and wilderness study areas to establish baseline conditions for assessment of long-term ecosystem trends. A total of 20 sites were planned for the initial 5-year period. A standardized monitoring platform is operating at these sites and includes measurements of climate and atmospheric chemistry.

#### National Park Service

The National Park Service (NPS) monitors air quality and visibility in several national parks and monuments. Gaseous pollutants data are collected on continuous and integrated (24-hour) bases. Surface meteorological data are collected and analyzed for hourly averages. Precipitation chemistry is determined on week-long integrated rainfall samples. Twenty-four hour, average

particle concentrations (mass, elemental analyses, some chemical constituent analyses) are measured twice weekly. Atmospheric light extinction is measured continuously and relayed to a central location for analyses.

The NPS also conducts and contracts research to develop and test air quality models to assess long-range transport, chemical transformation, and deposition of air pollutants. These models are used to estimate source contributions to, and to identify source regions responsible for observed pollutant loadings.

#### United States Geological Survey

The Survey's Water Resources Division (WRD) collects streamflow, precipitation, and other climatological data for a number of projects concerning rainfall/runoff, water quality and hydrologic processes. Currently, the Geological Survey collects hydrometeorological data from approximately 5,130 remote data collection platforms (DCP). The data are transmitted to Wallops, Virginia, via GOES and rebroadcast to a domestic communication satellite (DOMSAT). Data are received from the DOMSAT by local readout ground stations (LRGS) procured by the Geological Survey under a 1992 contract. The USGS currently operates 15 LRGS' which provide near real-time data to the Survey's computerized National Water Information System. The USGS also collects precipitation samples in a number of studies for the determination of atmospheric contribution to the chemical constituent loads to runoff and for defining the effect of atmospheric deposition on water quality and the aquatic environment.

The USGS is continuing a joint research program with the National Aeronautics and Space Administration (NASA) and the Department of Agriculture (USDA) to map snowpack water equivalent or depth using satellite passive microwave observations from the Defense Meteorological

Satellite Program SSM/I sensor. The satellite observations are being compared to snowpack data from a variety of sources: USDA's Natural Resources Conservation Service (NRCS) automatic Snotel sites; National Weather Service (NWS) sites; and observations by USGS field teams which include grain size, density, and stratigraphy. The object of the program is to develop algorithms to extract snow depth or water equivalent information from the satellite observations for near real-time assessments and for climatological studies using the two decade long satellite record. An algorithm has been developed which combines the satellite observations with surface temperature measurements to account for changing snowpack grain size--a factor that was not included in previous algorithms.

The Survey also carries out research in past climate change, regional hydrology, the carbon cycle, coastal erosion, volcanic activity, and glaciology. As part of its glaciology program, the Survey maintains a benchmark pro-

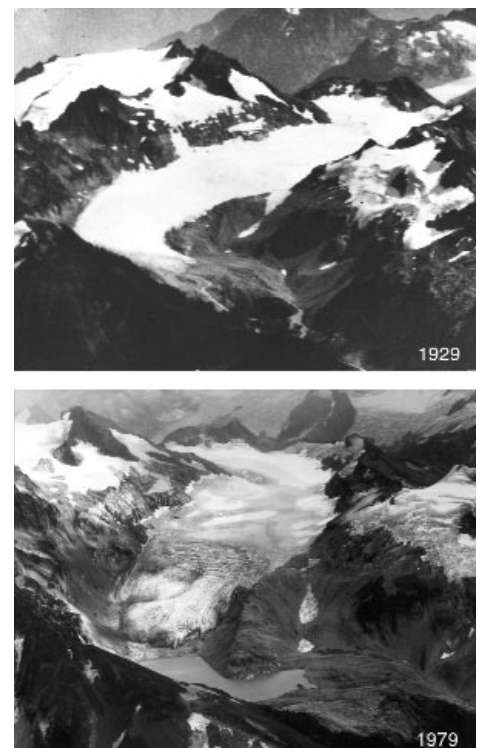


Figure 3-DOI-2. Aerial photographs capture the recession of the South Cascade Glacier in the State of Washington.

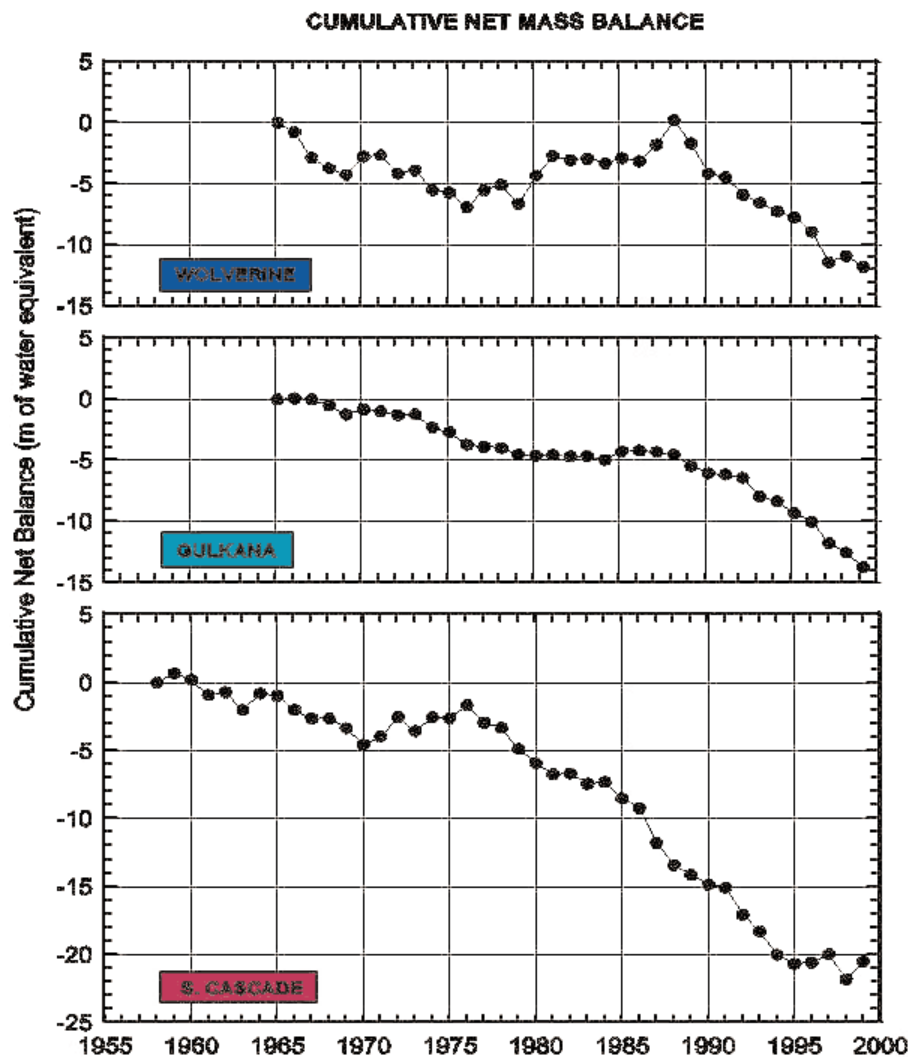


Figure 3-DOI-3. USGS monitors the decreasing mass of glaciers in Washington and Alaska.

gram on three benchmark glaciers representative of different climatic zones of the western United States—one in Washington (Figure 3-DOI-2), one on the south coast of Alaska, and one in the interior of Alaska. At each glacier, the program measures the winter snow accumulation, summer snow and ice ablation, air temperature, and runoff in the glacier basin. Analysis of this 37-year record is providing a greater understanding of the climate variability and its effects on water resources of the western United States. Both the snowpack and glaciology program now incorporate data supplied by the intelligence community through the coordination of the Civil Applications Committee (CAC) (Figure 3-DOI-3).

The Survey's Geologic Division,

through the USGS Geomagnetism Group in Golden, Colorado, collects data on temporal variations of the Earth's magnetic field from a global network of over 70 geomagnetic observatories. These observatories (which include 14 operated directly by USGS) all belong to the INTERMAGNET program. Under INTERMAGNET, data from a global network of geomagnetic observatories are transmitted in near real-time via satellites and computer links (E-mail) to collection and dissemination points called Geomagnetic Information Nodes (GIN's). Five GIN's are now located in Europe, North America, and Asia.

Magnetic field data are key inputs to the National Space Environment Forecast and Warning Program, which

is coordinated by the OFCM, and to the new inter-agency National Space Weather Program. These data are used for nowcasting, forecasting, and modeling of "space weather"—particularly the effects of geomagnetic disturbances. These effects range from: satellite computer upsets and early re-entry, to disruption of radio communications, to degradation of navigation systems (such as GPS), and to outages of power distribution grids. The roles and responsibilities of agencies participating in the National Space Environment and Warning Program are detailed in the "National Plan for Space Environment Services and Supporting Research, 1993-1997" (FCM-P10-1993) which was prepared by the OFCM Committee for Space Environment Forecasting.

The Survey participates in OFCM's Working Group for Volcanic Ash (WG/VA). This working group is preparing *A National Framework for Volcanic Ash Hazards to Aviation*. Through its Volcanic Hazards Program, the Survey is responsible for monitoring approximately 56 historically active volcanoes in the United States—44 are in Alaska. Until the 1980s, the Alaskan volcanoes had been largely unstudied. Despite the low population density of much of the state, Alaska's volcanoes underlie the heavily traveled air routes of the North Pacific region.

During recent years, the Survey's Alaskan Volcano Observatory (AVO) has expanded its network of real-time seismic monitoring stations. The expansion brought 21 of the state's volcanoes under continuous, real-time surveillance. Data and information from the AVO monitoring activities are integrated directly into the regional operational activities of the FAA, DOD, and NWS to provide warnings for pilots and aircraft operators in the Alaskan region.

Internationally, the OFCM WG/VA has supported expansion of the USGS



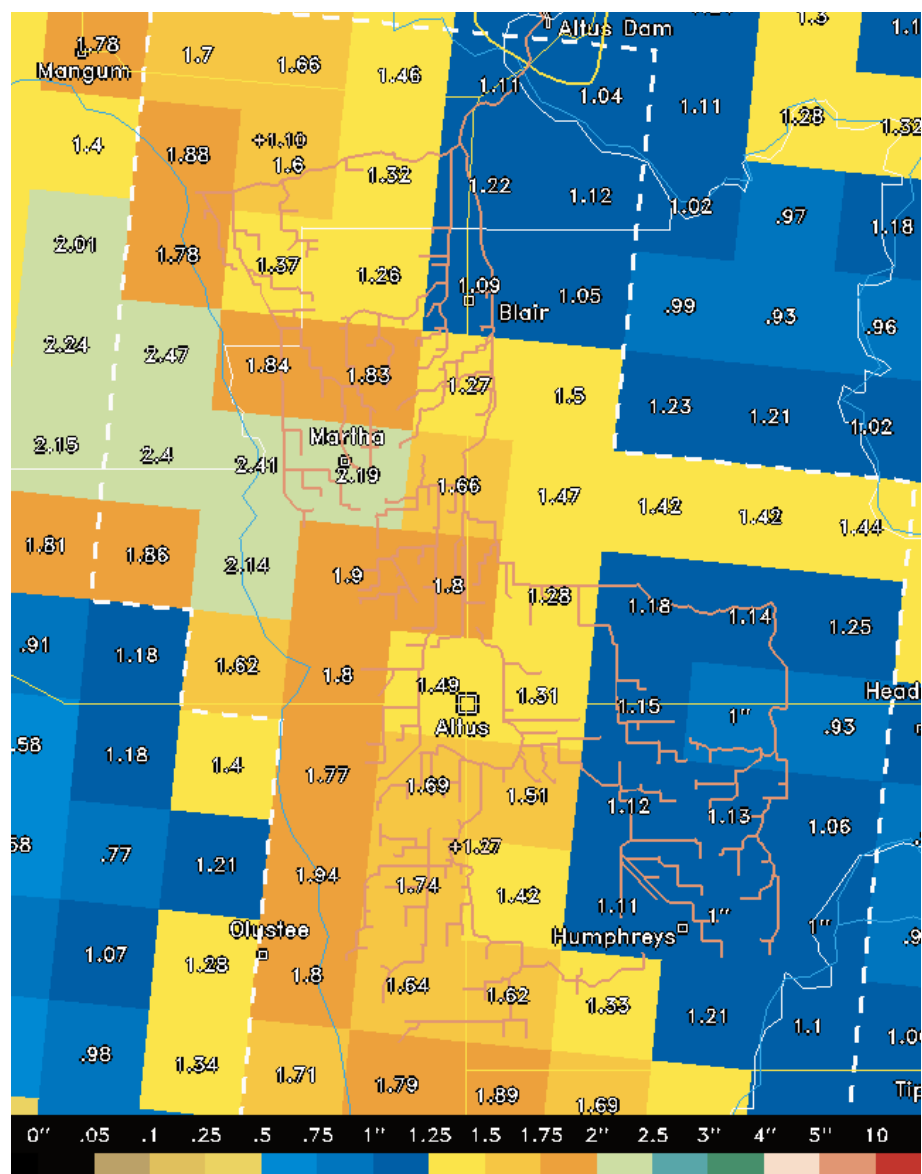


Figure 3-DOI-4. AWARDS System Interactive display enables users to click radar grid cells (within the white dashed line boundary) for a pop-up of the 24-hour estimated Crop Water Use charts. The user can also click on the weather stations for pop-up of the Daily Weather Data charts.

monitoring activities in the remote Pacific Rim of explosive volcanoes. The 100 historically active volcanoes in Alaska, Kamchatka, and the Kuriles are monitored through satellite imagery several times a day.

Currently, about 220 aircraft per day (carrying about 20,000 passengers and millions of dollars of cargo) transit the international Northern Pacific routes near these historically active volcanoes. Approximately one-half these flights are United States carriers. AVO, through its working agreement with the Kamchatka Volcanic Eruption

Response Team (KVERT) in Petropavlovsk-Kamchatsky, Russia, also supplies information about eruptive activity in Kamchatka and the Kuriles to the FAA, the NWS, and numerous domestic and foreign air carriers.

#### Bureau of Reclamation

The Bureau of Reclamation activities requiring the collection and use of meteorological data include water scheduling, flood hydrology, irrigation project management, and reservoir operations as well as projects related to hydroelectric energy resources. One

example of this is the Agricultural Water Resources Decision Support (AWARDS) (<http://yampa.earthsci.do.usbr.gov:8080/awards/>) system. AWARDS integrates high-resolution NEXRAD radar rainfall estimates, surface environmental data, crop models, and quantitative precipitation forecasts with watershed reservoir-canal systems and irrigation district water distribution systems. AWARDS provides operational support for (1) early warnings to reduce hydrologic risk for loss of property and lives, (2) improved efficiency in canal and reservoir operations, and (3) improved efficiency in irrigation scheduling for water conservation and water quality.

The Rio Grande Basin AWARDS system has been modified to compute consumptive use of crops and riparian vegetation for irrigation diversions and reaches of rivers served in the Upper Rio Grande Basin. This activity is accomplished in close cooperation with the NWS Forecast Office, West Gulf River Forecast Center, and the multi-agency Upper Rio Grande Water Operations Modeling team. Daily results of this EvapoTranspiration (ET) Toolbox are posted on the internet for water managers, irrigation districts, and municipal water users. (<http://yampa.earthsci.do.usbr.gov:8080/awards/Nm/riogrande.html>) (Figure 3-DOI-4) Daily ET Toolbox calculations are also imported into RiverWare--the river basin water operations modeling system. Similar work is planned for the Yakima Basin where the ET Toolbox will also be linked directly to a daily water operations model to determine consumptive losses and depletions. These models assist water managers in water conservation decision-making. AWARDS systems are also being implemented for the Tualatin and Rogue River Basins in western Oregon and in the South Platte in northeastern Colorado.

Reclamation researchers finalized the NEXRAD Operational Support

Facility (OSF) report on the Snow Accumulation Algorithm (SAA). Researchers will continue improvement efforts and also apply the algorithm to Reclamation watersheds through their Research and Technology Transfer Program and NOAA's Global Energy and Water Cycle Experiment (GEWEX) Continental-Scale International Program (GCIP) cooperative partnership. GEWEX is part of the World Climate Research Program. The SAA development was a cooperative effort with the tri-agency WSR-88D OSF in Norman, Oklahoma. The prototype is being successfully field tested in the northern Plains from Minnesota to Montana on a daily basis and results are displayed on the Web for Reclamation's water managers as well as NWS forecasters and River Forecast Centers. Previous work demonstrated the prototype capabilities at Albany, New York, Cleveland, Ohio, and Minneapolis Minnesota. Work is planned to apply these algorithms and precipitation estimation techniques for the GEWEX Applications Prediction Program (GAPP) in the West beginning in FY 2002.

Reclamation's NEXRAD research team is also conducting cooperative work with the National Oceanic and Atmospheric Administration's (NOAA) GCIP. This work involves developing a correction scheme for known snowfall underestimation at far range caused by the curvature of the earth and the vertical profile of radar reflectivity. Reflectivity during snowfall has maximum values near the ground. In addition, Reclamation and GCIP are cooperating on providing snow water equivalent (SWE) estimates to the NOAA National Operational Hydrologic Remote Sensing Center which will incorporate them into their overall scheme of SWE and snow cover mapping for the nation. These spatial snow distributions are used by NWS River Forecast Centers and other

agencies as input to runoff and streamflow models. Therefore, improved knowledge of SWE and snow cover distributions, resulting from including NEXRAD radar estimates, will provide more accurate streamflow forecasts. Improved forecasting will, in turn, allow better management of water resources.

Reclamation meteorologists are working on modifying their snow accumulation algorithm into a



*Managing Water in the American West*  
(Bureau of Reclamation web site)

Precipitation Accumulation Algorithm (PAA). This algorithm will provide a means of real-time estimation of precipitation rates and water equivalent over areas of particular interest. For example, Reclamation water managers need real-time warnings concerning flash flooding into reservoirs for which dam safety is a concern. Another example is accurate estimation of rainfall onto irrigation districts as part of the AWARDS system discussed earlier.

Multi-agency work on projecting potential effects of climate change and climate variability on western water resources and Bureau operations is continuing under collaborative work with NOAA's GCIP, Office of Global Programs, and the National Centers for Environmental Prediction (NCEP). The NWS RFCs provide detailed streamflow forecasts for Reclamation's operations. Of note is technology transfer efforts in the Central Valley

Operations Office in Sacramento, California, where a direct workstation link to the NWS River Forecast System and other hydrometeorological forecast products is providing Reclamation's water managers access to detailed products of immediate value to water management operations. This direct link to NWS products has proven invaluable for Central Valley Project Operations, particularly during periods of heavy precipitation and extreme events when timely information is readily available to water operations managers.

Other multi-agency studies are underway with the Los Alamos National Laboratory's remote sensing and coupled atmospheric and hydrologic modeling teams. Raman LIDAR measurements of water vapor fluxes over the riparian zones of the Bosque del Apache and crops are enhancing our knowledge of consumptive losses from salt cedar and cottonwood trees, and crop ET. Coupled modeling efforts to improve local mesoscale predictions of precipitation and runoff in the Upper Rio Grande Basin have begun using NCEP large-scale MRF models to initialize the Regional Atmospheric Modeling System and provide forecast stream flows using the USGS Modular Modeling System. This effort is part of the NSF sponsored Sustainable Semi-arid Science and Technology Center research at the University of Arizona.

Another collaborative effort is beginning with ERL's Climate Diagnostics Center's Western Water Initiative in collaboration with the Cooperative Institute for Research in Environmental Sciences (CIRES). This effort involves the validation, quantification of uncertainty, and development of water management applications for extended weather and climate forecasts. This Office of Global Programs sponsored research complements the GAPP and upcoming Water Cycles multi-agency applied

hydrometeorological research programs.

A Technology Advancement study of heavy precipitation events in collaboration with NCEP and the National Center for Atmospheric Research (NCAR) is examining the utility of mesoscale models for simulation and prediction of extreme precipitation events. These efforts are taking current technologies and applying them to very heavy precipitation events to determine maximum precipitation and better understand limits of extreme precipitation in watersheds above Reclamation facilities for safety of dams studies and early warning applications. Additionally, under the Technology Advancement program, Reclamation and representatives from the NWS Office of Hydrology are currently in the process of updating rainfall-frequency estimates for both the Ohio River Region and Upper Midwest Region of the United States. Results of these studies will eventually replace those estimates obtained in Technical Papers Nos. 40 & 49 (Weather Bureau 1961 and 1964, respectively).

Currently, Reclamation's HYDROMET system collects data from approximately 400 hydrometeorological DCPs which transmit data in the "real-time" through the GOES to the Bureau's DRGS in Boise, Idaho. AGRIMET is another network of 60 DCPs dedicated to analysis of crop

water use and water conservation in the Pacific Northwest. Data collected and products created in Boise are electronically transferred to other Bureau, federal, and state offices. Funding for Reclamation's Global Change Response Program ended in the mid-1990s. Reclamation's weather modification research program has not been funded since 1989 except for reimbursable work.

#### Minerals Management Service

The Minerals Management Service's (MMS) Environmental Studies Program gathers offshore environmental data for use in the management of offshore oil and gas resources. Currently, MMS is funding the continued operation of five meteorological buoys which transmit data via NOAA satellites. Two buoys are located in the Gulf of Mexico and two in the Pacific Ocean off California. The MMS also utilizes data from other buoys funded by NOAA. The buoys collect air temperature, sea surface temperature, wind direction, wind speed, wave height, and wave spectrum data.

In FY 1998, the MMS started data collection from two 915-MHz profilers with RASS to study the atmospheric boundary layer over the Gulf of Mexico. One profiler is located on a platform about 6 miles off the central Louisiana coast; the other is placed in deeper waters about 130 km from shore. Hourly observations are transmitted to the NWS via GOES satellite

on a real-time basis for use in prognostic models. Data collection started in June 1998 and will last for three years. Each site also collects surface data on wind, temperature, relative humidity, atmospheric pressure, and sea surface temperature. The MMS initiated a 3 year study to synthesize the data from the two profilers along with data from various other sources in the Gulf of Mexico and adjacent onshore area. The goal of this effort is to establish a data base on marine boundary layer and atmospheric dispersion characteristics in the Gulf.

The MMS has requested the offshore oil and gas industry to establish a network of meteorological stations in the offshore area around the Breton National Wilderness Area in Louisiana to collect data for air quality modeling. Meteorological surface data will be collected from a number of offshore platforms and buoys. In addition, three radar profilers with RASS will be installed to collect upper air data. This effort is being funded by industry and data collection is expected to start in April 2000. Data will be collected for one year.

#### Bureau of Indian Affairs

The Bureau of Indian Affairs collects atmospheric data to evaluate potentially irrigable Indian Trust lands in the Southwest. The Bureau also shares fire weather data with other Federal agencies while participating in fire weather forecasting at NIFC.